CLAIMS

1. A preform formed with a plurality of reinforcing fiber substrates stacked to each other and each made of at least reinforcing fiber yarns, comprising through holes which extend through a plurality of said reinforcing fiber substrates in a thickness direction of said preform.

2. The preform according to claim 1, wherein substantially no cut end of reinforcing fiber filament exists in said through holes.

3. The preform according to claim 1 or 2, wherein a short diameter of each of said through holes is in a range of 0.1 to 3 mm.

4. The preform according to any of claims 1 to 3, wherein each of said reinforcing fiber substrates is fixed in its fabric style.

5. The preform according to any of claims 1 to 4, wherein a resin material, whose main component is a thermoplastic resin, is interlaminated between layers of said reinforcing fiber substrates in said preform.

6. The preform according to any of claims 1 to 5, wherein a volume content of reinforcing fibers Vpf of said preform is in a range of 45 to 62%.

7. The preform according to any of claims 1 to 6, wherein a volume content of reinforcing fibers Vpf (%) of said preform is in a range of $Vf-5 \leqq Vpf \leqq Vf+5$ relatively to a volume content of reinforcing fibers Vf(%) of an FRP which is obtained by molding said preform.

8. The preform according to any of claims 5 to 7, wherein a content of said resin material is in a range of 1 to 20% by weight relatively to said preform.

9. The preform according to any of claims 5 to 8, wherein said resin material has a particle form.

10. The preform according to any of claims 5 to 8, wherein said resin material has a form of an organic fiber fabric formed by organic fiber yarns.

11. The preform according to any of claims 1 to 10, wherein each of said reinforcing fiber substrates is formed as a unidirectional sheet stabilized in form at a condition where said

reinforcing fiber yarns are arranged in one direction in parallel to each other.

12. The preform according to any of claims 1 to 10, wherein each of said reinforcing fiber substrates is formed as a unidirectional woven fabric having a form in which said reinforcing fiber yarns are arranged in one direction in parallel to each other and having a weave structure in which auxiliary yarns are arranged in the other direction.

13. The preform according to any of claims 1 to 10, wherein each of said reinforcing fiber substrates is formed as a bidirectional woven fabric having a weave structure in which said reinforcing fiber yarns are arranged in parallel to each other in longitudinal and transverse directions, respectively.

14. The preform according to any of claims 1 to 13, wherein each of said reinforcing fiber substrates is formed as a multiaxially stitched substrate in which reinforcing fiber yarns arranged in parallel to each other form layers and these layers are integrated by stitch yarns.

15. The preform according to any of claims 1 to 14, wherein said preform has a stepped portion with a different stacking number of said reinforcing fiber substrates.

16. The preform according to any of claims 1 to 15, wherein said through holes are locally provided at arbitrary positions in plane.

17. An FRP molded by impregnating a matrix resin into a preform according to any of claims 1 to 16 and curing the resin.

18. The FRP according to claim 17, wherein a volume content of reinforcing fibers Vf of said FRP is in a range of 45 to 70%.

19. The FRP according to claim 17 or 18, wherein use of said FRP is a primary structural member, a secondary structural member, an outer panel or an inner panel of transportation means of an airplane, an automobile or a ship.

20. A process for producing a preform comprising:

a stacking step for forming a plurality of reinforcing fiber substrates each made of at least reinforcing fiber yarns and stacking a plurality of these substrates in a preform mold; and

a penetrating step for forming through holes which extend through a plurality of said reinforcing fiber substrates in a thickness direction of a stacked body.

21. The process for producing a preform according to claim 20, wherein said preform is produced by at least the following steps (A) to (E) carried out in order:

(A) a stacking step for forming a plurality of reinforcing fiber substrates each made of at least reinforcing fiber yarns and stacking a plurality of these substrates in a preform mold;

(B) a disposing step for disposing a stacked body, formed by said stacking step, in a preform mold;

(C) a heating step for heating said stacked body and bonding respective layers, each comprising a reinforcing fiber substrate and a resin material, at least partially;

(D) a cooling step for cooling said stacked body; and

(E) a penetrating step for forming through holes which extend through a plurality of said reinforcing fiber substrates in a thickness direction of said preform.

22. The process for producing a preform according to claim 20, wherein said preform is produced by at least the following steps (F) to (K) carried out in order:

(F) a stacking step for forming a plurality of reinforcing fiber substrates each made of at least reinforcing fiber yarns and stacking a plurality of these substrates in a preform mold;

(G) a penetrating step for stacked body for penetrating a plurality of said reinforcing fiber substrates with a needle or a pin in a thickness direction of a stacked body formed by said stacking step;

(H) a disposing step for disposing said stacked body in a preform mold;

(I) a heating step for heating said stacked body and bonding respective layers, each comprising a reinforcing fiber substrate and a resin material, at least partially;

(J) a cooling step for cooling said stacked body; and

(K) a removing step for removing said needle or said pin.

23. The process for producing a preform according to any of claims 20 to 22, wherein a

needle or a pin having a length of its short axis of 0.1 to 3 mm is used in said penetrating step.

24. The process for producing a preform according to any of claims 20 to 23, wherein a through hole is formed while applying a ultrasonic wave to a needle or a pin in said penetrating step.

25. The process for producing a preform according to any of claims 20 to 24, wherein a needle or a pin used in said penetrating step is integrated with a pressing plate disposed on said preform mold or said stacked body.

26. The process for producing a preform according to any of claims 20 to 25, wherein a length of a needle or a pin used in said penetrating step is set at a length equal to a thickness of a required preform, and said preform thickness is controlled by bridging said needle or said pin between a pressing plate disposed on said stacked body and said preform mold.

27. The process for producing a preform according to any of claims 20 to 26, wherein one of preform molds to be disposed is a bagging material and the other is a male mold or a female mold.

28. The process for producing a preform according to any of claims 21 to 27, wherein, said heating step, said preform is pressed at an atmospheric pressure by enclosing said stack body in said preform mold in said disposing step (B) or (H) in advance and reducing a pressure in said preform mold to an atmospheric pressure or less.

29. A process for producing an FRP by using a preform according to any of claims 1 to 16 and by at least the following steps (L) to (N):

(L) a setting step for disposing said preform in a mold;

(M) an injecting step for injecting a liquefied matrix resin into said mold to impregnate said matrix resin into said preform; and

(N) a curing step for curing said matrix resin.

30. The process for producing an FRP according to claim 29, wherein, said setting step (L), said mold is formed by at least a female mold or a male mold and a bagging material.

31. The process for producing an FRP according to claim 29 or 30, wherein, said setting step (L), a resin distributing medium is stacked on an outermost surface of said preform, and in said injecting step (M), after said matrix resin is preferentially injected into said resin distributing medium, the resin is impregnated in a thickness direction of said preform through said through holes, the resin is impregnated in a plane direction of said preform from said through holes, and the resin is thus impregnated over the entire preform.